



Video over the Internet Can we break the Net?

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- From Wikipedia: IPTV (Internet Protocol Television) is a system where a <u>digital television</u> service is delivered using the <u>Internet Protocol</u> over a network infrastructure, which may include delivery by a <u>broadband</u> connection ...
- For clarity on this talk:
 - Will focus on the "public" Internet as a many-many node network and not private IPTV installations which cable and telco companies are installing
 - Will primarily discuss one->many video needs. The complexities around user generated content will not be discussed. That would be an entirely separate discussion



- CBS Entertainment (cbs.com)
- CBS News (cbsnews.com)
- Sportsline (cbs.sportsline.com)
- StarTrek.com
- Entertainment Tonight
- Showtime (sho.com)

CBS Interactive AS6102 and 6641

- 3 Data Centers:
 - New York
 - Miami
 - Los Angeles
- ~1200 Servers
- 26Gbps Uplink Capacity
 - All transit today
 - Exploring direct connections with networks which have large consumer bases
- Utilize two external CDN vendors







- Big-4 network (CBS, ABC, Fox, NBC)
- All primetime Regularly-Scheduled
 Programs
- 2005/2006 Season
- Average Household Share 11%
- Average Viewers 10.9 Million

Source: Nielsen Media Research, NTI, 05/06 Season (9/19/2005 - 5/24/2006), Mon-Sat 8-11p & Sun 7-11p, Persons 2+, "Most Current" (Live/Live+7).

CBS Television Ratings Top-10 Show

• 2005/2006 Season

- Big-4 network (CBS, ABC, Fox, NBC)
- Top 10 Regularly-Scheduled Prime Programs
- Average Household Share 21%
- Average Viewers 22.0 Million
- 2007 NFL Super Bowl
 - Broadcast on CBS
 - Average Household Share 64%
 - Average Viewers 93.2 Million

Source: Nielsen Media Research, NTI, 05/06 Season (9/19/2005 - 5/24/2006), Mon-Sat 8-11p & Sun 7-11p, Persons 2+, "Most Current" (Live/Live+7). Superbowl, Nielsen Fast Nationals

CBS Television Technology

- The media industry has covered entire regions with Television signals since the 1920s
- A single over-the-air transmitter covers an entire local market
 - The entire US market is covered from one satellite transponder
- The size and location of the transmitter determines coverage area. This holds if one or one million people are watching
- WCBS-TV (DT/HDTV) New York is serviced with one 349 Kilowatt transmitter on the Empire State Building which covers the entire New York City Market

Source: www.fcc.gov

CORPORATION Television Technology New York City Market



Source: www.fcc.gov

- For the media industry bursting traffic is normal
- 10x burst is a small event
- Sports and Entertainment traffic is known in advance
 - Though not how large a peak might be
 - For this weekends Super Bowl we had a 300% increase in traffic in under 90 seconds
- News gives "no" warning
 - The best one might get is a few days notice, e.g.:
 State Funeral for President Ford last month
- Being off the air during any event is not acceptable
 - What would happen if we had a BGP reset during the final 2 minutes of any sporting event?

CBS Traffic Planning Live Event



Internal CBS graph representing a single distribution node for a live event

*Apx 1.2Gbps

* This was a live talk show that was apx 1 hour in length and immediately rebroadcast, thus the two peaks

OCBS CORPORATION **Traffic Planning** Live vs Video on Demand

- Live events are our biggest challenge from a Internet point of view
- Live is a requirement for our business
 - When was the last time you watched a sporting event after you knew the outcome?
 - Would you watch a news event completely after it is over, or just the two minute highlight?
- Video on Demand (VOD)
 - Utilizes a normalized traffic pattern which allows us to build and sustain the base networking infrastructure
 - VOD works for content that people want to time-shift
 - Such as a full episode of CSI the day after first run airing

CORPORATION Internet Video

- Windows Media, Real, Flash
- Unicast IP TCP/UDP
- Quality of service matters A LOT
- Currently a Internet "high" bit rate video is 600Kbps
 - DVD: 2Mbps-8Mbps
 - HDTV: ~19Mbps
 - Blue-ray: ~36Mbps
- Quality will continue to rise
 - As a company, CBS wants our content to look as good as it possibly can
 - If enough people can sustain a 2Mbps video feed we
 WILL up our bit rates



- How would we broadcast a single live show
 - Use the CSI episode which aired on the CBS Television Network on Thursday November 16, 2006
 - The New York Market ratings for that one show
 - Average Household Share 22%
 - Average Viewers 1,537,000
- Unicast Bandwidth
 - 650Kbps stream
 - Viewers watch all 60 minutes
 - 999Gbps = 650,000 bits * 1,537,000 users
 - 359TB served (650kbps * 60sec * 60 mins * 1.537M users)
 - What would that cost to deploy if you could deploy a 1Tbps network commercially?

Source: Nielsen Media Research, NTI



- Provided access to games which were not being broadcast to your local market
 - TV Viewers during Internet Peak: 4.7 Million
 - Average TV Viewers for all NCAA Tournament Games:
 9.4 Million
- 400Kbps video feed or a 33Kbps audio
 - We did not broadcast a lower bit rate video feed for content quality reasons
- 268,000 peak users First Thursday afternoon
- 2007 Changes
 - Increasing to a 500Kbps video feed
 - Tech/Business goal is to double 2006 capacity
- ALL UNICAST/Traditional Technologies

OCBS New Video Technologies?

- Can the Internet scale with only unicast?
- Will true multicast ever be enabled?
 - RFC 3376 Internet Group Management Protocol, Version 3. October 2002
- Peer to peer is an interesting technology
 - Asynchronous nature of current home links does not contribute to full off loading of all transport
 - There are already VOD solutions in place with other companies
 - We are watching it closely
 - We will run selected trials with these sorts of systems
- Who gets paid?

OCBS CORPORATION Peer to Peer Example - 600kbps stream

Assumptions

- Video/Audio encode rate of 600kbps
- 100,000 viewers
- 50% of viewers are on 768/256Kbps links
- 50% of viewers can serve 1Mbps up
- 60Gbps Event in total, of which:
 - 12.8Gbps is available from the 256Kbps uplinks
 - 50Gbps is available from the 1Mbps uplinks
 - Origin traffic is therefore a single 600Kbps feed from CBS
 - My ISP provides me with a single T1 ...
- Math does not work if users do not have bandwidth
 - 1Mbps stream is not possible in a world where the majority of users have a 768Kbps downlink capacity

Note: Math in this is horribly simplified - assumes no tcp headers/retransmission



More Bandwidth for streams

600Kbps is just "acceptable" on a computer screen



CORPORATION Future Directions 56 Mbps vs 600 Kbps



56 Mbps HDTV Sample



600 Kbps Sample

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CORPORATIONFuture Directions56 Mbps vs 600 Kbps



56 Mbps HDTV Sample



600 Kbps Sample

CORPORATION Future Directions 56 Mbps vs 600 Kbps



56 Mbps HDTV Sample



600 Kbps Sample

CORPORATION Future Directions

- More Bandwidth for streams
 - 600Kbps is just "acceptable" on a computer screen
- New Devices
 - Devices such as the Apple TV unit, have Internet connections and 1080i output through a HDMI cable
 - There are a lot of 50+ inch flat screen HDTV units that people will want to utilize
- There will be more consumers on line at all times

- All of us enjoy building large complex networks
- Will the Internet "replace" over-the-air broadcast technology as a transmission method?
- Will consumers want to get high quality content?
- CBS will be where the consumers are regardless of device, encode rates or content type

CORPORATION Parting Thoughts

- Broadcast media ties people together
- The media industry will continue to evolve to meet consumer demand
- Let us change positions
 - How would you guarantee that everyone who needed a piece content could get it?
 - When, where and how they want it?
- Tuesday September 11, 2001



- Video Internet: The Next Wave of Massive Disruption to the U.S. Peering Ecosystem (v1.2)
 - William B. Norton <u>wbn@equinix.com</u>
- SMPTE Motion Imaging Journal January 2007



Questions